



# MURANG'A UNIVERSITY OF TECHNOLOGY

## SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL AND BIOLOGICAL SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF  
SCIENCE IN ANALYTICAL CHEMISTRY, INDUSTRIAL CHEMISTRY AND  
EDUCATION SCIENCE**

ACH 102 – ORGANIC CHEMISTRY I

DURATION: 2 HOURS

DATE: 16<sup>th</sup> April 2019

TIME: 2:00-4:00 pm

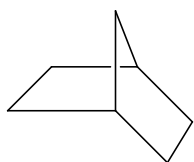
**Instructions to candidates:**

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

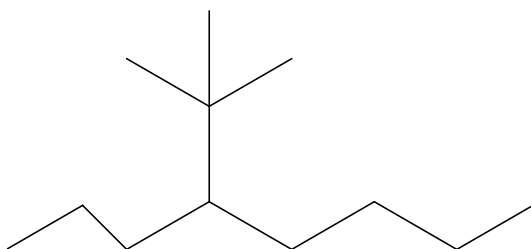
**SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION**

**QUESTION ONE (30 MARKS)**

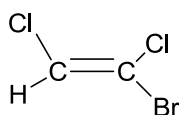
- a) Provide systematic (IUPAC) names for the following compounds indicating stereochemistry where possible. (5 marks)



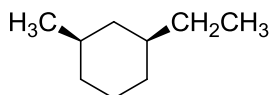
(i)



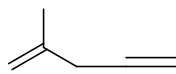
(ii)



(iii)



(iv)

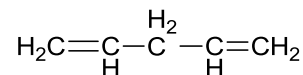
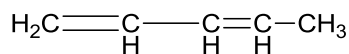
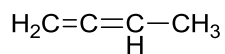


(v)

- b) Draw structures for each of the following (5 marks)

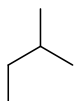
- 2,3-dimethylcyclopentene
- Bicyclo[1.1.0.]butane
- 5-bromo-1-chloro-2-iodo-3-methylpentane
- 1-6-heptadiyne
- Trans*-1,2-dimethylcyclopentane

- c) Classify the following alkene systems as isolated, cumulated or conjugated



(3 marks)

- d) Microbromination of methylcyclobutane with molecular bromine in presence of light gives a mixture of micro brominated products
- Draw all possible monobrominated isomers of the above reaction. (4 marks)
  - Draw the isomer in d(i) above that would be formed in highest quantity and give a reason. (2 marks)
- e) Three different alkenes were accidentally mixed. But when this mixture was hydrogenated in the presence of a metal catalyst, only one alkene of the given structure was formed. Draw all possible structures of the alkenes. (3 marks)

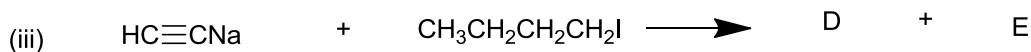
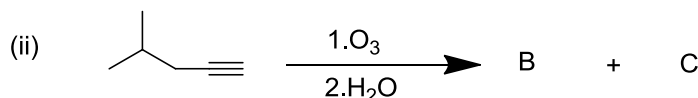


- f) Combustion of a 5.17g of a sample of a compound Q gives 10.32g of CO<sub>2</sub> and 4.23g of water. The molecular weight of the compound is 88. Use atomic weights of C=12.02, H=1.008 and O=15.99.
- What is the percentage composition of oxygen in compound Q? (2 marks)
  - Calculate the empirical formula of compound Q. (2 marks)
  - What is the molecular formula of compound Q? (2 marks)
- g) Define the following terms (2 marks)
- Bond dissociation energy
  - Bond energy
- h) Name one factor that dictate the products during the cracking of alkenes. (1 mark)

**SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION**

**QUESTION TWO (20 MARKS)**

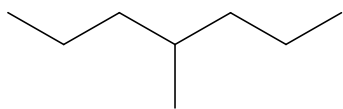
a) Complete the following reactions by providing the major products expected. (5 marks)



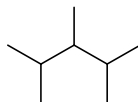
b) Write the equation of the reaction that take place when 2-chlorobutane reacts with potassium hydroxide in alcoholic solution. Identify the major product and account for the major product. (3 marks)

c) Give three roles that alkenes play in biological systems. (3 marks)

d) Which of the following products is expected to have a higher octane number and why? (2 marks)



P



Q

e) Arrange the following in the increasing order of bond length (1 mark)

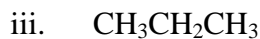


f) Explain why alkyl halides have higher boiling point than alkanes with the same carbon atoms. (1 mark)

g) Explain how you can distinguish 2-chloropentane from chlorobenzene in a laboratory (2 marks)

h) Given the molecules below, indicate for each which have polar covalent, covalent, coordinate covalent. (3 marks)

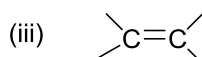
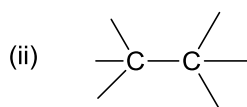




**QUESTION THREE (20 MARKS)**

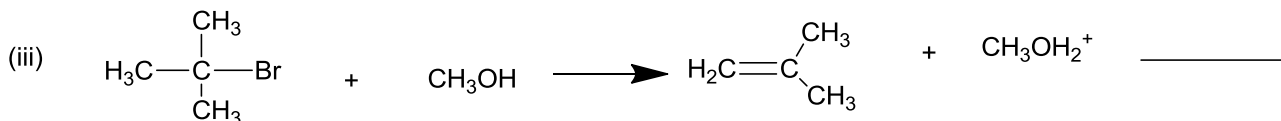
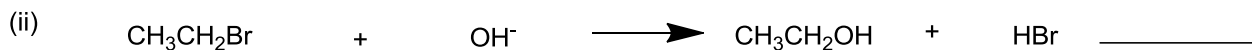
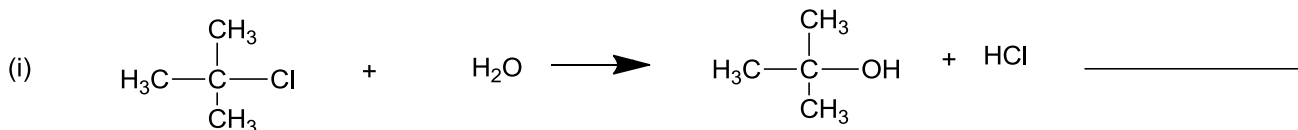
a) In preparation of n-heptane explain why reaction of bromomethane, 1-bromohexane and sodium cannot be used and suggest another method that can be used to prepare n-heptane with equations. (4 marks)

b) Given the following, indicate the type of hybridization in each



(3 marks)

c) In the reaction represented by the following equations, label the reaction as  $\text{SN}^1$  or  $\text{SN}^2$ ,  $\text{E1}$  or  $\text{E2}$ . (3 marks)



d) Give four possible isomeric structures with molecular formula  $\text{C}_4\text{H}_9\text{Br}$  indicating their IUPAC names. (4 marks)

e) Give four uses of alkyl halides (4 marks)

f) Write a balanced equation to show the products formed when compound Q below completely burns in oxygen. (1 mark)

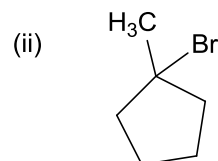
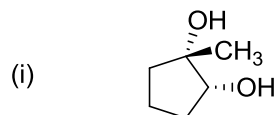


Q

g) Define the term pyrolysis. (1 mark)

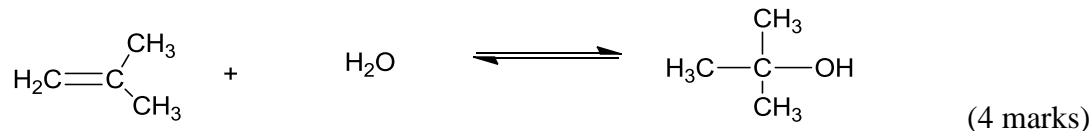
#### QUESTION FOUR (20 MARKS)

- a) Give the mechanism of reaction when ethane reacts with chlorine in presence of light showing initiation, propagation and termination steps. (6 marks)
- b) Explain why alkenes are more reactive than alkanes (2 marks)
- c) Show how the following compounds can be prepared from 1-methylcyclopentene

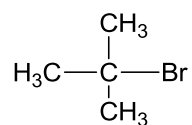


(3 marks)

- d) Given ethane and ethene, which compound is more soluble than the other in water, and why? (2 marks)
- e) Given the following equation, show the mechanism of reaction



- f) Given the following alkyl halides,  $\text{CH}_3\text{Br}$ ,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ ,  $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$  and



arrange them in increasing order of reaction rates

(1 mark)

- g) Give two commercial uses of alkynes (2 marks)